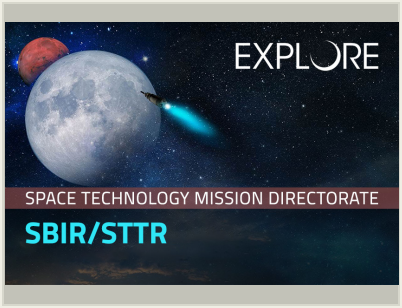
Robotic Tool Changer for Planetary Exploration, Phase I

Completed Technology Project (2008 - 2008)

Project Introduction

Future planetary exploration missions will require compact, lightweight robotic manipulators for handling a variety of tools & instruments without increasing the weight of the robot arm. The current design philosophy of MER, Beagle 2, Phoenix & MSL, sees select tools and instruments permanently affixed to the arm end-effector. Future missions will be size & mass constrained and will need to be more capable than their predecessors. One technical solution that would enable deployment of multiple tools and instruments from a compact, lightweight manipulator is an electromechanical coupler or tool changing mechanism which can reliably take a tool or instrument out of a magazine and couple it, form-locking and force-locking, to the end-effector. The program's ultimate goal is to develop and demonstrate a highly reliable and scalable robotic tool-change system in a relevant environment from a relevant robotic platform. In Phase I, we will perform a detailed investigation of robotic tool-changer requirements, design strategies and tall poles for robotic systems exploring Mars and the Moon, including first order experiments to verify feasibility of specific enabling design features. Requirements such as cycles, stiffness, strength, repeatability, misalignment-tolerance and electrical characteristics will be derived by considering MER and Phoenix as models for instrument type and operational patterns, robotic arm capability and environment and by deriving future mission requirements. There are a few terrestrial applications (ROVs in the off-shore oil industry) and space applications (Shuttle and ISS RMS Latching End-Effector system) for which a subset of design strategies may be applicable. We will consider these and leverage lessons learned from our experience with (1) electromechanical systems for MER, Phoenix and MSL which perform reliably in dusty environments and (2) our high TRL designs for electrical and mechanical robotic connections both for Mars and on-orbit.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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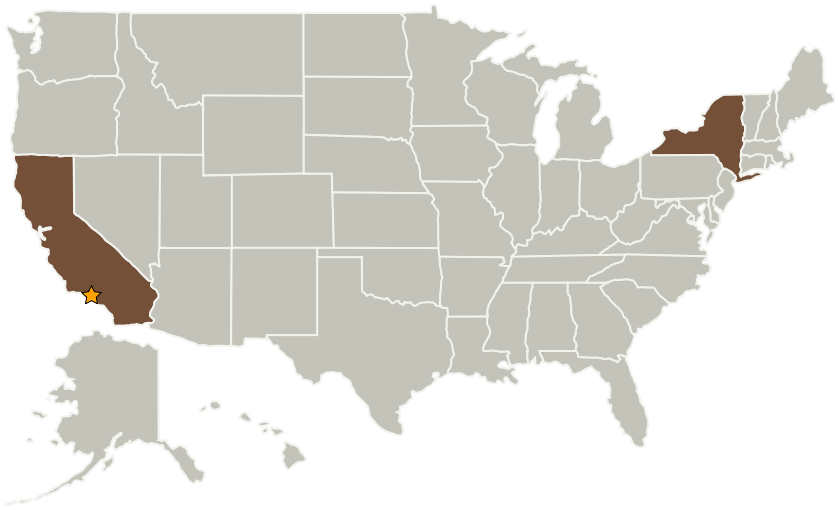
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
Honeybee Robotics, Ltd.	Supporting Organization	Industry	Pasadena, California

Primary U.S. Work Locations	
California	New York

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Kiel Davis

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.3 Manipulation
    - TX04.3.1 Dexterous Manipulation